

Galilean Satellites and the Galileo Space Mission

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Jupiter's Galilean satellites have been of great scientific interest since their discovery in 1610. Because the periods of the inner three satellites are in the ratio of 1:2:4, the satellites obey the so-called Laplace libration which is of importance for the evolution of the Galilean system.

Earth- and spacecraft-based data were employed in developing ephemerides in support of the Galileo space mission. An analysis of CCD astrometric observations from 1992-1994, of photographic observations from 1967-1993, of mutual event astrometric data from 1973-1991, of Jovian eclipse timing data from 1652-1983, of Doppler data from 1987-1991, and of optical navigation data from the Voyager spacecraft encounter in 1979, produced the satellite ephemerides for the Galileo space mission.

The Galileo spacecraft arrived at Jupiter in December 1995 to start its two-year mission of exploring the Jovian system. The spacecraft will complete eleven orbits around Jupiter and have ten more close encounters with of the outer three Galilean satellites, after the initial Io close approach on December 7, 1995. Since the Io encounter occurred closer to Io than originally designed, the spacecraft energy change was greater than nominally planned and resulted in an initial period about 7 days less than that designed in the nominal tour. A 100-km change in the Io-encounter distance results in an 8-day change in initial period of the spacecraft. Hence the first Ganymede encounter was moved forward one week, but all other encounters would occur on their nominal dates. This was accomplished without expending spacecraft fuel and resulted in the first Ganymede flyby occurring on June 27 rather than the nominally scheduled July 4. During the Galileo mission, the satellite ephemerides will be calculated via numerical integration with an analytic theory as the back-up.

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